GENERAL INSTRUMENT	APPLICATION NOTE AN-0505 REVISION C	SP0256A-AL2 CTS256A-AL2

CODE-TO-SPEECH CHIP SET

FEATURES:

-Unlimited vocabulary
-Utilizes letter-to-sound rules
-Serial or parallel interface
-Microprocessor available for user code

DESCRIPTION

The Code-to-Speech chip set consists of two chips: the SP0256A-AL2, an allophone-based single chip speech synthesizer, and the CTS256A-AL2, an 8-bit microcomputer programmed with a letter-to-sound based algorithm. This chip set translates English characters into LPC synthesized speech sounds.

SP0256A-AL2

The SP0256A-AL2 is General Instrument's standard allophone chip and is based on the SP0256A speech synthesizer. This synthesizer consists of a 10 or 12 pole second-order cascaded LPC filter, a controller, and a 16-Kbit ROM in which 59 allophones (speech sounds) and five pauses are stored.

CTS256A-AL2

The CTS256A-AL2 is a PIC7041 whose on-board ROM is masked with our code-to-speech algorithm. This algorithm converts English text (in the form of standard ASCII characters) into SP0256A-AL2 compatible allophone addresses, using letter-to-sound rules.

General Instrument's PIC7041 is a licensed second source of the TMS7041.

TWO-CHIP SOLUTION

This chip set delivers highly recognizable speech output from any peripheral device or computer in a flexible and cost effective manner. It can be configured as a dedicated code-to-speech system, as well as add speech output to a user's program running in this CTS256A-AL2 from off-chip Rom. Such user programs are written in PIC7001 assembly language which is 100% compatible with TMS7001 assembly language. (Refer to PIC7001 Data Sheet, DS33001A).

Eproms can be added to improve the pronunciation of certain proper names, acronyms and technical words (see "EXCEPTION-WORD" eprom); as well as to store user programs (see "USER" eprom).

PIN SELECTABLE CODE-TO-SPEECH OPTIONS:
Refer to TABLE 1.

INPUT INTERFACE	-Serial port & baud rate vs. Parallel port
INPUT BUFFER	-Internal RAM vs. External RAM
DELIMITER	-Any-delimeter vs. Carriage-return-only
UART PARAMETERS	-Program defaults vs. 74LS373 selectable (or eprom definable)

FIRMWARE (EXCEPTION-WORD/USER EPROM) CONTROLLED CODE-TO-SPEECH OPTIONS: (optional)
Refer to TABLE 2.

-Parallel port decode relocatable
-UART parameters 74LS373 decode relocatable
-UART parameters selectable
-Start & end address of External-Ram relocatable

CODE-TO-SPEECH ALGORITHM FEATURES:

-ESCAPE: 'ESC',(1B Hex) THE ESCAPE-KEY CODE WILL DUMP THE CONTENTS OF THE INPUT AND OUTPUT BUFFERS, AND WILL ALSO SILENCE SPEECH OUTPUT WHICH IS IN PROGRESS.

-BACKSPACE:'←',(08 Hex) THE BACKSPACE-KEY CODE ERASES THE INPUT BUFFER ONE CHARACTER AT A TIME, BEGINNING WITH THE LATEST ENTRY.

NOTE: The R/C combination indirectly connected to PIN 14 of the CTS256A-AL2 and to PIN 2,25 of the SP0256A-AL2 acts as a power-on reset. The requirement to reset the chip-set is a negative-going pulse which remains Lo for a minimum of 500 µS.

NOTE: A signal (input or output) that is Active-LO is designated by its signal name followed by an asterik (*).

NOTE: The program default address decode of the SP0256A-AL2's ALD* input is 2000H. It is re-definable via the EXCEPTION-WORD or USER eprom. Refer Table 2.

NOTE: MSnibble means most significant nibble, where a nibble is half a byte.
MSB means most significant byte; LSB means least significant byte.
'X' stands for the MSnibble of the MSB of the two byte address, and can be 1,2,3,4,5,6,7,8,9,A,B,C,D,or E because an eprom may reside from 1000H to E000H.

NOTE: The term 'delimeter' refers to any punctuation following a word or numerical sequence. These include: , . ; : ! ? spaces and carriage-returns.

CODE-TO-SPEECH ALGORITHM

Upon power-up (or hardware reset) the CTS256A-AL2 determines the system configuration with respect to the following five options:

1- INTERNAL / EXTERNAL RAM SELECTION: (Refer to TABLE 1.)

INTERNAL-RAM mode has an input buffer which accomodates words or phrases that are no greater than 19 characters in length followed by a delimeter) and an output buffer that accomodates an allophone translation of that word or phrase that is no greater than 26 allophone addresses.

Since the translation more often than not results in the output buffer contents consisting of two times that of the input buffer, words no longer than 13 characters in length and numerical sequences no longer than 4 numbers in length should be used as a rule of thumb. If the output buffer overflows, what has not been spoken yet from the output buffer might be lost, and the BUSY1 flag will not necessarily show an input buffer empty status even though the input buffer might be empty. If a translation results in an output buffer overflow, the system reset may have to be used to clear the system.

EXTERNAL-RAM mode can be used to extend the size of the input and output buffers. If no EXCEPTION-WORD or USER eproms are present, the start address default is 3000H. Static RAM can be added in 256 byte contiguous block increments, beginning with a minimum of 512 bytes. The algorithm will find the end address by searching for the first non-RAM location at 256 byte intervals. The search for the end address will not progress beyond 2K bytes.

If an eprom is present, the start and end addresses are re-definable there. Requirements are: minimum start address is 0200H; the start address must begin on a boundary where the LSByte of the address =00; and without the end address specified in eprom, the maximum valid start address is EE00H.

In any case, 256 bytes are taken for the output buffer) the remainder is the input buffer. (External-Ram used must have an access time of 250 nS or less.)

2- ROM: A search is made from 1000H to E000H in 4K increments for the 5 byte sequence (80H,48H,28H,58H,85H) which uniquely identifies the presents of an EXCEPTION-WORD or USER eprom. If neither are present, the system options are set to algorithm default values or can be chosen by the Pin selectable options. If only a USER eprom is present, the system options may be re-defined from the USER eprom; refer to APPENDIX-D. If both USER and EXCEPTION-WORD eproms are present or if only an EXCEPTION-WORD eprom is present, the system options may be re-defined from the EXCEPTION-WORD eprom;refer to APPENDIX-A,B. (External-Rom used must have an access time of 300 nS or less.)

EXCEPTION-WORD EPROM(s): (optional)

Exception-word eprom(s) may reside anywhere within the decodeable address space of the CTS256A-AL2 from 1000H to E000H, providing its start address falls on a 4K boundary. The code-to-speech initialization routine will search for its existence which is denoted by a unique 5-byte sequence of numbers (80H,48H,28H,58H,85H). A few other locations in the primary exception-word eprom are reserved, and must contain specific sequences of numbers; the remainder are user-defined. Additional exception-word eprom(s) contiguous to the primary exception-word eprom contain no reserved locations. Refer to APPENDIX-A,B for the applicable EXCEPTION-WORD EPROM MEMORY MAP.

... is accompanied by an EXCEPTION-WORD eprom, it may reside anywhere. If no EXCEPTION-WORD eprom accompanies it then it may reside anywhere from 1000H to E000H providing its start address falls on a 4K boundary; and it must then begin with the sequence B0H,48H,28H,58H,85H; and also contain other reserved locations.
If an EXCEPTION-WORD eprom is present, the USER's program can even reside in an unused portion of the EXCEPTION-WORD eprom.
Refer to APPENDIX-D,E for the applicable USER EPROM MEMORY MAP.

Interaction between a USER program and the code-to-speech algorithm must be controlled in an orderly manner, ie; the user must save the processor status before taking control of the processor for execution of any USER code (except for character string loading operations, which is described next!)

To prepare the code-to-speech algorithm to process and speak, the USER program passes the character string it wants spoken into the Accumulator one character at a time, then calls the routine @SAVE which transfers it into the input buffer. After the character string loading has been completed, the USER code can initiate the speech by calling the @SPEAK routine; assuming that a delimeter followed that character string. After the loaded character string is processed and spoken, program control resumes in the hands of the USER program by the Branch @USERCODE instruction.

No registers used by the code-to-speech algorithm may be disturbed by the USER code during character string loading, (except for the Accumulator).

Prior to the USER code executing anything other than character string loading, all registers used by the code-to-speech algorithm as well as the Stack Pointer and STATUS register are to be saved. These registers must be recovered prior to future character string loading operations; or prior to initiating speech.

Because of masked code-to-speech restrictions within the CTS256A-AL2, Interrupt-1# and Interrupt-3# are not USER accessible. Also, input from the serial port into the USER code can be obtained, but restrictions apply.

Refer to APPENDIX-F for a discussion of the sequence of events and subroutines necessary for USER / CODE-TO-SPEECH interactions as described above.

3- SERIAL / PARALLEL INPUT INTERFACE SELECTION: (Refer to TABLE 1.)

In the parallel mode, ASCII data is latched by an 74LS374, upon receipt of an Active-LO data-valid strobe. This strobe also vectors the algorithm to accept the data via Interrupt-3#, PIN 12 of the CTS256A-AL2. The latch's address default is 200H. It is re-definable from EXCEPTION-WORD or USER eprom. (Refer to TABLE 9 for timing requirements of the parallel port.)

In the serial mode, ASCII data is accepted via the CTS256A-AL2 PIN 16, which is a built-in UART that requires a TTL level signal input.
The baud rate is selectable at 50,110,300,1200,2400,4800, and 9600. The other UART parameters are set to algorithm default values, or are hardware selectable via an 74LS373 buffer. The buffer address default is 1000H. The UART parameters as well as the baud rate is re-definable from EXCEPTION-WORD or USER eprom. The algorithm default UART values are: Asynchronous, 7 bits/character, 2 stop bits, and no parity.

In either serial or parallel mode, the input buffer is protected from overflow by a hysteresis subroutine which signals the host when the input buffer is full, and when the input buffer is ready for additional input. Hardware handshaking (BUSY#) is provided to accomplish this signaling of input buffer status.

BUSY# is Active-LO. It toggles LO when the input buffer becomes 87.5% full. In this way the host system may use its discretion to complete that transmission or a part thereof. If the input buffer becomes 100% full, the parallel and serial port interrupts are disabled to prevent input buffer overwrite; and the interrupts are not re-enabled until the input buffer full condition has dissipated. BUSY# will toggle HI when the input buffer becomes 50% empty; at which time the interrupts are enabled if they had been disabled by a 100% full condition. (BUSY# is PIN-3 of the CTS256A-AL2.

4- SOFTWARE / HARDWARE (or FIRMWARE) UART PARAMETERS SELECTION: (Refer to TABLE 1.)

This hardware option tells the code-to-speech algorithm to use the default UART values, or to find the parameters at the 74LS373 buffer. The buffer address default is 1000H. The UART parameters are re-definable from eprom, but only if the hardware mode is selected via Pin 9 of the CTS256A-AL2.

5- ANY-DELIMETER / CARRIAGE-RETURN-ONLY SELECTION: (Refer to TABLE 1.)

In the any-delimiter mode, the code-to-speech algorithm will process and speak words or phrases as soon as they are followed by any delimiter. In the carriage-return-only mode, the algorithm will process and speak words or phrases only after a carriage-return is received as a delimeter. The carriage-return-only mode is meant for use with a slow input device such as a terminal, where the user wishes to buffer-up a complete phrase so that it is spoken with fluency. If the carriage-return-only mode is chosen in conjunction with EXTERNAL-RAM, limit to 160 characters the length of the phrase which is entered before the carriage-return is entered. This allows for a two line phrase to be spoken with fluency while insuring that the 256 byte output buffer should not overflow.

After completion of the initialization the phrase "O.K." is spoken to demonstrate that the system is ready for input, then one of the following two paths is taken dependent upon the system configuration:

1: In a 'dedicated code-to-speech system' (ie; USER eprom is not present), the algorithm idles as long as the input buffer remains empty. Input is via standard ASCII characters. Processing begins with an alphabetical search of the EXCEPTION-WORD eprom, if it is present. If no exact match for the character string is found, or if an EXCEPTION-WORD eprom is not present, the algorithm employs a letter-to-sound rule table against which main, right, and left context matches are performed. This results in the translation of a particular word into the proper string of allophone addresses necessary for its pronunciation. This list of allophone addresses is sent to the SP0256A-AL2 after a carriage-return, or after any delimiter depending upon the mode selected.

2: In the 'add speech to USER's program' mode (ie; USER eprom is present), control of the processor is relinquished to the USER code immediately after the initialization is complete. The USER code may then execute its own code, may pass character strings into the input buffer memory, or may hand-off processor control to the code-to-speech algorithm to speak any previously loaded character strings. If speech is initiated, control returns to the USER code after the last delimited character string in the input buffer has been processed. Refer to APPENDIX-F.

TABLE 1.

Hardware selectable option pin-outs of CTS256A-AL2:

PIN 6 7 8

0 0 0 ←PARALLEL INPUT MODE
0 0 1 BAUD 50
0 1 0 BAUD 110
0 1 1 BAUD 300
1 0 0 BAUD 1200
1 0 1 BAUD 2400
1 1 0 BAUD 4800
1 1 1 BAUD 9600

SERIAL INPUT MODE

PIN 9
0←PROGRAM DEFAULT UART VALUES (Asynchronous, 7 bits/character, 2 stop bits, no parity).
1←HARDWARE (or FIRMWARE) SELECTED UART VALUES.

PIN 10
0←INTERNAL-RAM BUFFERS, (20 BYTE INPUT/26 BYTE OUTPUT).
1←EITERNAL-RAM BUFFERS, (1792 BYTE INPUT/256 BYTE OUTPUT WITH A 2-KBYTE RAM), (EX: TMS4016-25).

PIN 11
0←CARRIAGE-RETURN-ONLY DELIMITER.
1←ANY DELIMITER.

PIN 03 "BUSY" (Input buffer flag is a TTL level output); for RS232 compatibility use MC1488 Line Driver or equiv.
0→INPUT BUFFER IS >=87.5% FULL.
1→INPUT BUFFER IS <=50.0% EMPTY.

PIN 16→UART RECEIVER (Serial input is a TTL level input); for RS232 compatibility use MC1489 Line Receiver or equiv.

NOTE: 0 implies TLL LO level; 1 implies TTL HI level.
← implies input; → implies output.

A typical connection to a computer with an RS232 interface:

COMPUTER		CODE-TO-SPEECH CHIP-SET
protective GND	←→	signal GND (Circuit ground).
signal GND	←→	signal GND (Circuit ground).
Clear To Send (CTS)	←	Request To Send (RTS) = CTS256A-AL2's PIN 3 (BUSY).
Transmitter's Line Driver	→	CTS256A-AL2 UART's Line Receiver.

TABLE 2. NEW PARAMETERS.

1009	FF	NUMBER OF BYTES OF 50% OF EXTERNAL INPUT BUFFER (MSB)
100A	FF	NUMBER OF BYTES OF 50% OF EXTERNAL INPUT BUFFER (LSB)
100B	FF	NUMBER OF BYTES OF 12.5% OF EXTERNAL INPUT BUFFER (MSB)
100C	FF	NUMBER OF BYTES OF 12.5% OF EXTERNAL INPUT BUFFER (LSB)
100D	FF	EXTERNAL RAM START ADDRESS (MSB) see note 2.3
100E	FF	EXTERNAL RAM START ADDRESS (LSB) see note 2.3
100F	FF	EXTERNAL RAM END ADDRESS-100H (MSB) see note 2.3
1010	FF	EXTERNAL RAM END ADDRESS-100H (LSB) see note 2.3
1011	FF	EXTERNAL RAM START ADDRESS-1 (MSB) see note 2.3
1012	FF	EXTERNAL RAM START ADDRESS-1 (LSB) see note 2.3
1013	FF	EXTERNAL RAM END ADDRESS-FFH (MSB) see note 2.3
1014	FF	EXTERNAL RAM END ADDRESS-FFH (LSB) see note 2.3
1015	FF	EXTERNAL RAM END ADDRESS+1 (MSB) see note 2.3
1016	FF	EXTERNAL RAM END ADDRESS+1 (LSB) see note 2.3
1017	FF	ADDRESS DECODE OF SP0256A-AL2's ALD# (MSB) see note 2.4
1018	FF	ADDRESS DECODE OF SP0256A-AL2's ALD# (LSB) see note 2.4
1019	FF	ADDRESS DECODE OF 74LS374 PARALLEL PORT LATCH (MSB)
101A	FF	ADDRESS DECODE OF 74LS374 PARALLEL PORT LATCH (LSB)
101B	FF	see note 2.1
101C	FF	TOTAL NUMBER OF BYTES IN INPUT BUFFER (MSB)
101D	FF	TOTAL NUMBER OF BYTES IN INPUT BUFFER (LSB)
101E	FF	see note 2.1
101F	FF	see note 2.1
1020	FF	SERIAL PORT MODE REGISTER (see table 5) see note 2.5
1021	FF	SERIAL PORT CONTROL REGISTER (see table 6) see note 2.5
1022	FF	SERIAL PORT TIMER DATA REGISTER (see table 6) see note 2.5

YOUR EXCEPTION-WORD OR USER EPROM CAN RESIDE ANYWHERE FROM 1000H TO E000H PROVIDING IT BEGINS ON A 4k BOUNDARY WHERE X=1,2,3,4,5,6,7,8,9,A,B,C,D,or E. (The least significant 3 nibbles of the address must remain as shown.)

NOTE 2.1 THESE LOCATIONS MUST BE FF, (THEY ARE NOT USER DEFINABLE).
NOTE 2.2 TO MAINTAIN ANY PARAMETER AT ITS DEFAULT VALUE, LOAD THAT LOCATION WITH FFH.
NOTE 2.3 IF ANY OF THE EXTERNAL RAM BUFFER PARAMETERS ARE REDEFINED HERE, ALL OF THEM MUST BE REDEFINED HERE.
NOTE 2.4 NO MATTER WHAT ADDRESS IS CHOSEN FOR ALD#, THAT ADDRESS THRU THAT ADDRESS + 3FH IS RESERVED FOR SP0256A-AL2 ADDRESSING.
NOTE 2.5 IF ANY OF THE SERIAL PORT PARAMETERS ARE REDEFINED HERE, ALL OF THEM MUST BE REDEFINED HERE.
NOTE 2.6 H, AS IN 100H REFERS TO HEXADECIMAL NOTATION.
NOTE 2.7 A NIBBLE IS HALF OF A BYTE, OR 4 BITS.

TABLE OF ASSEMBLED ALPHABETIZED EXCEPTION-WORD INDEX

I0A3	I1	MSB OF POINTER TO START OF EXCEPTION-WORD BEGINNING WITH "A"
I0A4	93	LSB
I0A5	I1	MSB "A"
I0A6	A8	LSB "B"
I0A7	I1	MSB "B"
I0A8	A9	LSB "C"
I0A9	I1	MSB "C"
I0AA	B1	LSB "D"
I0AB	I1	MSB "D"
I0AC	B2	LSB "E"
I0AD	I1	MSB "E"
I0AE	B3	LSB "F"
I0AF	I1	MSB "F"
I0B0	B4	LSB "G"
I0B1	I1	MSB "G"
I0B2	E1	LSB "H"
I0B3	I1	MSB "H"
I0B4	E2	LSB "I"
I0B5	I2	MSB "I"
I0B6	0D	LSB "J"
I0B7	I2	MSB "J"
I0B8	0E	LSB "K"
I0B9	I2	MSB "K"
I0BA	0F	LSB "L"
I0BB	I2	MSB "L"
I0BC	1B	LSB "M"
I0BD	I2	MSB "M"
I0BE	1C	LSB "N"
I0BF	I2	MSB "N"
I0C0	1D	LSB "O"
I0C1	I2	MSB "O"
I0C2	1E	LSB "P"
I0C3	I2	MSB "P"
I0C4	2D	LSB "Q"
I0C5	I2	MSB "Q"
I0C6	2E	LSB "R"
I0C7	I2	MSB "R"
I0C8	2F	LSB "S"
I0C9	I2	MSB "S"
I0CA	30	LSB "T"
I0CB	I2	MSB "T"
I0CC	3D	LSB "U"
I0CD	I2	MSB "U"
I0CE	5A	LSB "V"
I0CF	I2	MSB "V"
I0D0	5B	LSB "W"
I0D1	I2	MSB "W"
I0D2	64	LSB "X"
I0D3	I2	MSB "X"
I0D4	65	LSB "Y"
I0D5	I2	MSB "Y"
I0D6	6F	LSB "Z"
I0D7	I2	MSB "Z"
I0D8	70	LSB "NUMBER OR PUNCTUATION"
		"NUMBER OR PUNCTUATION"

The least significant nibble of the MSB and the entire LSB address locations will vary with a different set of exception words; I=1,2,3,4,5,6,7,8,9,A,B,C,D,or E.

YOUR EXCEPTION-WORD EPROM CAN RESIDE ANYWHERE FROM 1000H TO F000H PROVIDING IT BEGINS ON

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    13 6E 24  AA:DB 19,110,36,185,19,90,11,1,33,19,0,18,15,0,1,65,34,39,20,141
X196 B9 13 5A 0B 01 21 13 00 12 0F
X1A0 00 01 41 22 27 14 8D
               ;<[ANDY]<=[AE NN1 PA2 DD2 IY PA1 DH1 AX PA1 PA2 GG3 RR2 EY TT2]  ANDY-THE-GREAT
X1A7 FF           DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X1A8 FF        BB:DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X1A9 13 61 B0  C:DB 19,97,176,33,106,20,137;<[CAP]A=[KK1 EY PP]                 CAPABILITY
X1AC 21 6A 14 89
X1B0 FF           DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X1B1 FF        D: DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X1B2 FF        E: DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X1B3 FF        F: DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X1B4 13 E9 13  G: DB 19,233,19,74,7,11,51,62,0,12,11,55,13,39,31,16,7,11,2,141
X1B7 4A 07 0B 33 3E 00 0C 0B 37 0D
X1C1 27 1F 10 07 0B 02 8D
               ;<[GI]<=[JH EH NN1 ER1 EL PA1 IH NN1 SS TT2 RR2 UW2 MM EH NN1 PA3 TT2]
               ;GENERAL INSTRUMENT
X1C8 13 E9 2D     DB 19,233,45,33,41,44,19,74,7,11,51,62,0,12,11,55,13,39,31,16,7,11,2,141
X1CB 21 29 2C 13 4A 07 0B 33 3E 00
X1D5 0C 0B 37 0D 27 1F 10 07 0B 02
X1DF 8D
               ;<[GI]MAIL<=[JH EH NN1 ER1 EL PA1 IH NN1 SS TT2 RR2 UW2 MM EH NN1 PA3 TT2]
X1E0 FF           DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X1E1 FF        H: DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X1E2 13 E4 13  I: DB 19,228,19,70,0,33,7,11,2,13,12,40,12,2,42,20,37,15,139;<[ID]<=[AY PA1
X1E5 46 00 21 07 0B 02 0D 0C 28 0C
X1EF 02 2A 14 25 0F 8B
               ;DD2 EH NN1 PA3 TT2 IH FF IH PA3 KK1 EY SH AX NN1]             IDENTIFICATION
X1F5 13 73 2C     DB  19,115,44,165,19,70,1,190;<[ISLE]<=[AY PA2 EL]                    ISLE
X1F8 A5 13 46 01 BE
X1FD 13 73 2C     DB 19,115,44,33,46,164,19,70,0,45,26,11,1,21,1;<[ISLAND]<=[AYPA2ELAENN1DD1]
X200 21 2E A4 13 46 00 2D 1A 0B 01
X20A 15 01
X20C FF           DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X20D FF        J: DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X20E FF        K: DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X20F 13 69 36  L: DB 19,105,54,37,164,19,109,12,35,3,149;<[LIVED]<=[LL IH VV PA4 DD1]    LIVED
X212 25 A4 13 6D 0C 23 03 95
X21A FF           DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X21B FF        M: DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X21C FF        N: DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X21D FF        O: DB 255
               ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X21E 13 75 32  P: DB 19,117,50,48,47,51,165,19,73,51,9,15,55,183;<[PURPOSE]<=[PPER1PPAXSSSS]
X221 30 2F 33 A5 13 49 33 09 0F 37
X22B B7
X22C FF           DB 255
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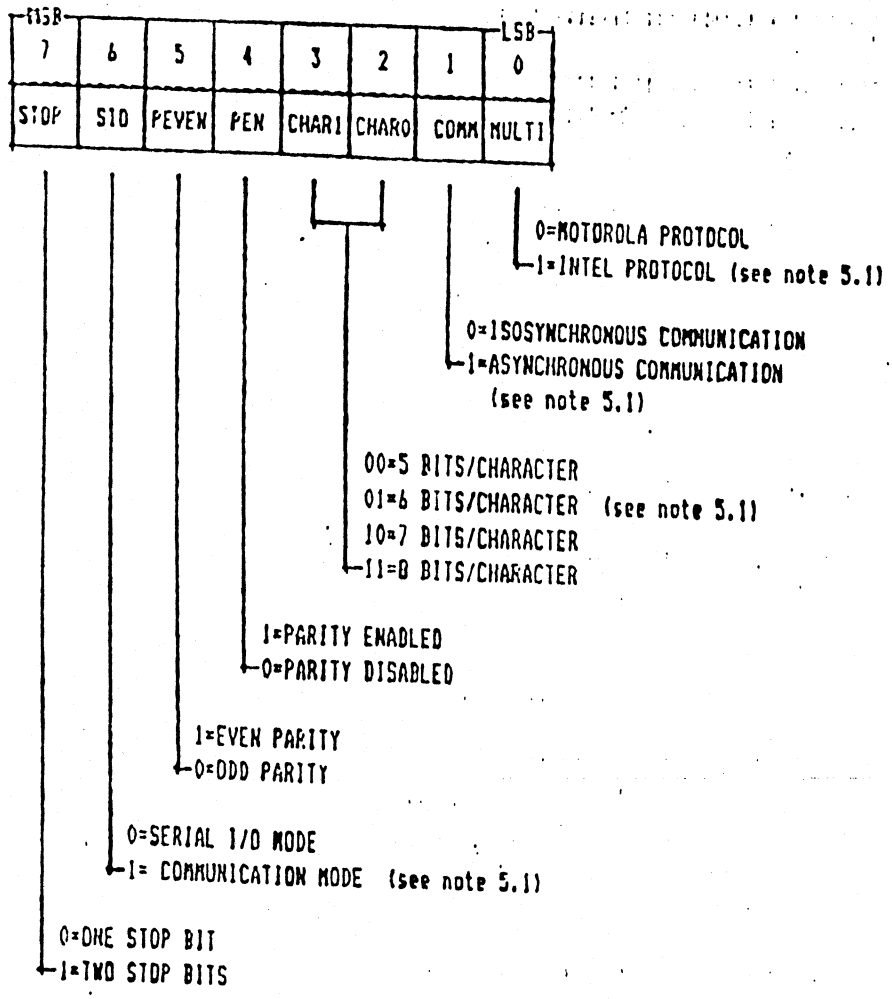
                ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X22D FF         Q: DB 255
                ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X22E FF         R: DB 255
                ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X22F FF         S: DB 255
                ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X230 13 6F 34  T: DB 19,111,52,33,172,19,77,53,13,0,15,190;<[TOTAL]<=[TT2 OW TT1 PA1 AX EL]
X233 21 AC 13 4D 35 0D 00 0F BE
X23C FF            DB 255
                ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X23D 13 73 25  U:DB 19,115,37,50,41,164,19,113,22,43,51,1,6,0,33,7,11,2,13,12,40,12,2,42,20,37
X240 32 29 A4 13 71 16 2B 33 01 06
X24A 00 21 07 0B 02 0D 0C 28 0C 02
X254 2A 14 25
X257 0F 8B          DB 15,139;<[USERID]<=[YY1 UW1 ZZ ER1 PA1 AY PA1 DD2 EH NN1 PA3 TT2 IH FF IH
                          ;PA3 KK1 EY SH AX NN1]
X259 FF            DB 255
                ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X25A FF         V: DB 255
                ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X25B 13 65 07  W: DB 19,101,7,50,165,110,19,180       ;<[WE'RE]=[WW IY ER2]           WE'RE
X25E 32 A5 6E 13 B4
X263 FF            DB 255
                ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X264 FF         X: DB 255
                ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X265 13 6F 35  Y: DB 19,111,53,7,50,165,19,89,186      ;<[YOU'RE]<=[YY2 OR]              YOU'RE
X268 07 32 A5 13 59 BA
X26E FF            DB 255
                ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X26F FF         Z: DB 255
                ;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
X270 13 CF 13  NUMORPUN: DB 19,207,19,89,58,1,16,7,55,55,12,1,10,0,2,42,26
X273 59 3A 01 10 07 37 37 0C 01 0A
X27D 00 02 2A 1A
X281 0B 01 3F   DB 11,1,63,19,0,55,55,2,9,53,2,42,7,11,0,46,12,29,0,18,15,0,2,13,15,2,50
X284 13 00 37 37 02 09 35 02 2A 07
X28E 0B 00 2E 0C 1D 00 12 0F 00 02
X298 0D 0F 02 32
X29C 00 0F 23   DB 0,15,35,0,20,0,2,42,19,128
X29F 00 14 00 02 2A 13 80
                ;<[/]<=[YY1 OR PA2 MM EH SS SS IH PA2 JH PA1 PA3 KK1 AE NN1 PA1 PA2 BB2 IY
                ;PA1 SS SS PA3 PP OW PA3 KK1 EH NN1 PA1 WW IH TH PA1 DH1 AX PA1 PA3
                ;TT2 AX PA3 CH PA1 AX VV PA1 EY PA1 PA2 KK1 EY PA1]YOU'RE MESSAGE CAN BE SPOKEN
                ;WITH THE TOUCH OF A KEY
                ;---------------------------------------------------------------
X2A6 C6 5A 0B      DB 198,90,11,21,128                  ;[&]=[AE NN1 DD1 PA1]            AND
X2A9 15 80
X2AB FF            DB 255                               ;MUST END EACH CATEGORY WITH [ ].
```

↑ WHERE X=1,2,3,4,5,6,7,8,9,A,B,C,D,or E. (The least significant 3 nibbles of the address will vary with a different set of exception words.)

TABLE 5. SERIAL PORT MODE REGISTER



NOTE 5.1 FOR A COMPLETE DESCRIPTION REFER TO PIC7001 Data Sheet, DS33001A.

FOR TYPICAL APPLICATIONS USE: MOTOROLA PROTOCOL, ASYNCHRONOUS COMMUNICATION, 7 BITS/CHARACTER, and COMMUNICATION MODE; THE NUMBER OF STOP BITS AND PARITY MODE REMAIN UP TO THE USER.

TABLE 6. SERIAL PORT CONTROL REGISTER / TIMER REGISTER

$$\text{Asynchronous Baud Rate} = \frac{2.5\ \text{MHz}}{64(PL + 1)(TL + 1)}$$

$$\text{Isosynchronous Baud Rate} = \frac{2.5\ \text{MHz}}{4(PL + 1)(TL + 1)}$$

where: PL = prescale latch value
TL = timer latch value

Example: To program the serial port to operate at 300 baud in the asynchronous mode, the prescaler value is set to 0, and the timer latch value to 8IH.

MSB 7	6	5	4	3	2	1	LSB 0
1	1	0	0	.0	0	PRE1	PRE0

2 BIT PRESCALE LATCH VALUE (PL)

MSB 7	6	5	4	3	2	1	LSB 0
TIMER LATCH VALUE (TL)							

TABLE 7. ASCII CHARACTER SET ENCODED VALUES

LETTER	ENCODED VALUE (shown in Hexadecimal).
A	21
B	22
C	23
D	24
E	25
F	26
G	27
H	28
I	29
J	2A
K	2B
L	2C
M	2D
N	2E
O	2F
P	30
Q	31
R	32
S	33
T	34
U	35
V	36
W	37
X	38
Y	39
Z	3A

TABLE B. ALLOPHONE ADDRESS ENCODED VALUES (shown in Hexadecimal).

ENCODED VALUE	ALLOPHONE	SAMPLE WORD	DURATION (ms)
00	PA1	PAUSE	10
01	PA2	PAUSE	30
02	PA3	PAUSE	50
03	PA4	PAUSE	100
04	PA5	PAUSE	200
05	OY	bOY	290
06	AY	sky	170
07	EH	End	50
08	KK3	Coab	80
09	PP	Pow	150
0A	JH	dodGe	400
0B	NN1	thiN	170
0C	IH	sIt	50
0D	TT2	To	100
0E	RR1	Rural	130
0F	AI	sUcceed	50
10	MM	Milk	180
11	TT1	parT	80
12	DH1	THey	140
13	IY	sEE	170
14	EY	bEIge	200
15	DD1	coulD	50
16	UW1	tO	60
17	AO	OUght	70
18	AA	hOt	60
19	YY2	Yes	130
1A	AE	hAt	80
1B	HH1	He	90
1C	BB1	Business	40
1D	TH	THin	130
1E	UH	bOOk	70
1F	UW2	fOOd	170
20	AW	OUt	250
21	DD2	Do	80
22	GG3	wiG	120
23	VV	Vest	130
24	GG1	Guest	80
25	SH	SHip	120
26	ZH	aZUre	130
27	RR2	bRain	80
28	FF	Food	110
29	KK2	sKy	140
2A	KK1	Can't	120
2B	ZZ	Zoo	150
2C	NG	aNchor	200
2D	LL	Lake	80
2E	WW	Wool	140
2F	XR	repaIR	250
30	WH	WHig	150
31	YY1	Yes	90
32	CH	CHurch	150
33	ER1	fIR	110
34	ER2	fIR	210
35	OW	bEAU	170
36	DH2	THey	180
37	SS	yeSt	60
38	NN2	No	140
39	HH2	Hoe	130
3A	OR	stORe	240
3B	AR	alARm	200
3C	YR	clEAR	250
3D	GG2	Got	80
3E	EL	saddLE	140
3F	BB2	Business	60

TABLE 9. PARALLEL PORT TIMING REQUIREMENTS:

SETUP TIME, BEFORE DATA CLOCK LO TO HI TRANSITION: MIN. 20 nS.
HOLD TIME, BEFORE DATA CLOCK LO TO HI TRANSITION: MIN. 10 nS.
WIDTH OF CLOCK LO: MIN. 500 nS.

HOLD OFF TIME, FROM DATA STROBE HI TO LO TO HI, UNTIL NEXT DATA STROBE HI TO LO: MIN. 450 uS.

NOTE: The addition of an 74LS74 Flip-Flop as shown on the schematic can be used for parallel port latch handshaking using the Active-LO LATCH-BUSY# output. LATCH-BUSY# is LO when the latch is full, and it is HI when the latch is empty and available for the next character to be strobed in.

EXCEPTION-WORD EPROM MAP (For use without USER eprom present)

NOTE: ENCAPSULATED SEQUENCES ARE USER-DEFINED, REFER TABLES 2,3, AND 4.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
1000	B0	48	28	58	B5	E0	35	E0	31	FF	FF	FF	FF	FF	FF	FF	←sample NEW PARAMETERS. (see table 2).
1010	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	
1020	FF	FF	FF	1E	1F	20	21	28	29	24	25	22	23	2A	2B	26	←NEW PARAMETER INITIALIZATION ROUTINE.
1030	27	2C	2D	2E	2F	32	33	34	35	36	E0	65	7B	02	31	BE	
1040	F1	43	C5	AA	10	09	2D	FF	E2	1E	B8	AA	10	23	D5	12	
1050	D0	13	B9	9B	13	C3	AA	10	09	2D	FF	E2	0B	B8	AA	10	The MSnibble of the following locations from the NEW PARAMETER INITIALIZATION ROUTINE are user defined also: I044,I04C,I057,I05F,I06E,I07E,and I084; where I=1,2,3,4,5,6,7,8,9,A,B,C,D,or E.
1060	23	D5	12	D0	13	B9	9B	13	5D	16	E6	E9	C3	AA	10	09	
1070	2D	FF	E2	14	A2	40	11	B2	11	A2	15	11	C3	AA	10	09	
1080	B2	15	C3	AA	10	09	B2	14	9B	29	03	9B	2B	07	22	20	
1090	9B	03	BE	F7	2B	9B	03	05	9B	07	09	9B	03	19	BC	F1	
10A0	00	E0	36	X1	93	X1	A8	X1	A9	X1	B1	X1	B2	X1	B3	X1	←sample ALPHABETIZED EXCEPTION-WORD INDEX, where X=1,2,3,4,5,6,7,8,9,A,B,C,D,or E. (see table 3).
10B0	B4	X1	E1	X1	E2	X2	0D	X2	0E	X2	0F	X2	1B	X2	1C	X2	
10C0	1D	X2	1E	X2	2D	X2	2E	X2	2F	X2	30	X2	3D	X2	5A	X2	
10D0	5B	X2	64	X2	65	X2	6F	X2	70	D8	02	D8	03	9B	03	11	←EXCEPTION-WORD ROUTINE.
10E0	BE	F7	4B	BE	F7	0F	77	01	0A	05	74	B0	0B	E0	03	73	
10F0	7F	0B	BE	F3	AF	76	20	0A	0E	52	34	AA	10	A3	D0	14	The MSnibble of the following locations from the EXCEPTION-WORD ROUTINE are user defined also: I0FC,I101,I10D,and I112; where X=1,2,3,4,5,6,7,8,9,A,B,C,D,or E.
1100	AA	10	A4	D0	15	E0	0F	C5	2A	41	2C	02	AA	10	A3	D0	
1110	14	AA	10	A4	D0	15	52	01	BE	F4	BB	BE	F4	C2	76	10	
1120	0A	4B	2D	FF	E2	60	9B	11	1D	73	BF	0A	BE	F5	64	76	
1130	10	0A	3C	BE	F4	7E	74	40	0A	BE	F5	64	76	10	0A	42	
1140	48	37	34	79	00	33	D5	37	73	FD	0B	52	02	BE	F4	BB	
1150	BE	F4	9E	9B	0F	03	9B	03	11	BE	F7	4B	77	B0	0B	0A	
1160	DB	39	BE	F3	47	C9	C9	BC	F1	36	C9	C9	BC	F3	F4	D3	
1170	15	E7	02	D3	14	52	02	BE	F4	BB	72	01	37	73	FD	0B	
1180	E0	99	52	03	E0	F1	D9	03	D9	02	D5	37	73	FD	0B	BC	
1190	F3	EE	FF	13	6E	24	B9	13	5A	0B	01	21	13	00	12	0F	←sample ENCODED EXCEPTION-WORDS. (see table 4).
11A0	00	01	41	22	27	14	BD	FF	FF	13	61	B0	21	6A	14	B9	
11B0	FF	FF	FF	FF	13	E9	13	4A	07	0B	33	3E	00	0C	0B	37	
11C0	0D	27	1F	10	07	0B	02	BD	13	E9	2D	21	29	2C	13	4A	
11D0	07	0B	33	3E	00	0C	0B	37	0D	27	1F	10	07	0B	02	BD	
11E0	FF	FF	13	E4	13	46	00	21	07	0B	02	0D	0C	28	0C	02	
11F0	2A	14	25	0F	BB	13	73	2C	A5	13	46	01	BE	13	73	2C	(see APPENDIX-C for discussion of encoding scheme.)
1200	21	2E	A4	13	46	00	2D	1A	0B	01	15	01	FF	FF	FF	13	
1210	69	36	25	A4	13	6D	0C	23	03	95	FF	FF	FF	FF	13	75	
1220	32	30	2F	33	A5	13	49	33	09	0F	37	B7	FF	FF	FF	FF	
1230	13	6F	34	21	AC	13	4D	35	0D	00	0F	BE	FF	13	73	25	
1240	32	29	A4	13	71	16	2B	33	01	06	00	21	07	0B	02	0D	
1250	0C	28	0C	02	2A	14	25	0F	BB	FF	FF	13	65	07	32	A5	
1260	6E	13	B4	FF	FF	13	6F	35	07	32	A5	13	59	BA	FF	FF	
1270	13	CF	13	59	3A	01	10	07	37	37	0C	01	0A	00	02	2A	
1280	1A	0B	01	3F	13	00	37	37	02	09	35	02	2A	07	0B	00	
1290	2E	0C	1D	00	12	0F	00	02	0D	0F	02	32	00	0F	23	00	
12A0	14	00	02	2A	13	B0	C6	5A	0B	15	B0	FF					

↑ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |

└—YOUR EXCEPTION-WORD EPROM CAN RESIDE ANYWHERE FROM

EXCEPTION-WORD EPROM MAP (For use with USER epro.

NOTE: ENCAPSULATED SEQUENCES ARE USER-DEFINED, REFER TABLES 2.., AND 4.

```
     |0 |1 |2 |3 |4 |5 |6 |7 |8 |9 |A |B |C |D |E |F
I000 B0 48 28 58 B5 E0 35 E0 31 FF FF FF FF FF FF FF   <-saaple
I010 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF     NEW PARAMETERS.
I020 FF FF FF 1E 1F 20 21 28 29 24 25 22 23 2A 2B 26   <-NEW PARAMETER
I030 27 2C 2D 2E 2F 32 33 34 35 36 E0 65 7B 02 31 BE     INITIALIZATION
I040 F1 43 C5 AA X0 09 2D FF E2 1E B8 AA X0 23 D5 12     ROUTINE.
I050 D0 13 B9 9B 13 C3 AA X0 09 2D FF E2 0B B6 AA X0   The MSnibble of the following locations
I060 23 D5 12 D0 13 B9 9B 13 5D 16 E6 E9 C3 AA X0 09   from the NEW PARAMETER INITIALIZATION
I070 2D FF E2 14 A2 40 11 B2 11 A2 15 11 C3 AA X0 09   ROUTINE are user defined also:
I080 B2 15 C3 AA X0 09 B2 14 9B 29 03 9B 2B 07 22 20   X044,X04C,X057,X05F,X06E,X07E,and X084;
I090 9B 03 BE F7 2B 9B 03 05 9B 07 09 9B 03 19 BC MS<-(see note 1 below).
I0A0 LS E0 36 X1 93 X1 AB X1 A9 X1 B1 X1 B2 X1 B3 X1   <-saaple
I0B0 B4 X1 E1 X1 E2 X2 0D X2 0E X2 0F X2 1B X2 1C X2     ALPHABETIZED
I0C0 1D X2 1E X2 2D X2 2E X2 2F X2 30 X2 3D X2 5A X2     EXCEPTION-WORD
I0D0 5B B2 64 B2 65 B2 6F B2 70 D8 02 D8 03 9B 03 11   <-EXCEPTION-WORD     INDEX, where X=1,2,3,4,5,6,7,8,9,A,B,C,D,or E.
                                                         (see table 3).
                                                         ROUTINE.
I0E0 BE F7 4B BE F7 0F 77 01 0A 05 74 B0 0B E0 03 73
I0F0 7F 0B BE F3 AF 76 20 0A 0E 52 34 AA B0 A3 D0 14   The MSnibble of the following locations
I100 AA B0 A4 D0 15 E0 0F C5 2A 41 2C 02 AA B0 A3 D0   from the EXCEPTION-WORD ROUTINE are user
I110 14 AA B0 A4 D0 15 52 01 BE F4 B8 BE F4 C2 76 10   defined also: X0FC,X101,X10D,and X112;
I120 0A 4D 2D FF E2 60 9B 11 1D 73 BF 0A BE F5 64 76   where X=1,2,3,4,5,6,7,8,9,A,B,C,D,or E.
I130 10 0A 3C BE F4 7E 74 40 0A BE F5 64 76 10 0A 42
I140 4B 37 34 79 00 33 D5 37 73 FD 0B 52 02 BE F4 B8
I150 BE F4 9E 98 0F 03 9B 03 11 BE F7 4B 77 B0 0B 0A
I160 DB 39 BE F3 47 C9 C9 BC F1 36 C9 C9 BC F3 F4 D3
I170 15 E7 02 D3 14 52 02 BE F4 B8 72 01 37 73 FD 0B
I180 E0 99 52 03 E0 F1 D9 03 D9 02 D5 37 73 FD 0B BC
I190 F3 EE FF 13 6E 24 B9 13 5A 0B 01 21 13 00 12 0F   <-saaple
I1A0 00 01 41 22 27 14 BD FF FF 13 61 B0 21 6A 14 B9     ENCODED
I1B0 FF FF FF FF 13 E9 13 4A 07 0B 33 3E 00 0C 0B 37     EXCEPTION-WORDS
I1C0 0D 27 1F 10 07 0B 02 BD 13 E9 2D 21 29 2C 13 4A     (see table 4).
I1D0 07 0B 33 3E 00 0C 0B 37 0D 27 1F 10 07 0B 02 BD
I1E0 FF FF 13 E4 13 46 00 21 07 0B 02 0D 0C 2B 0C 02
I1F0 2A 14 25 0F BB 13 73 2C A5 13 46 01 BE 13 73 2C
I200 21 2E A4 13 46 00 2D 1A 0B 01 15 01 FF FF FF 13   (see APPENDIX-C
I210 69 36 25 A4 13 6D 0C 23 03 95 FF FF FF FF 13 75   for discussion
I220 32 30 2F 33 A5 13 49 33 09 0F 37 B7 FF FF FF FF   of encoding scheee).
I230 13 6F 34 21 AC 13 4D 35 0D 00 0F BE FF 13 73 25
I240 32 29 A4 13 71 16 2B 33 01 06 00 21 07 0B 02 0D
I250 0C 2B 0C 02 2A 14 25 0F BB FF FF 13 65 07 32 A5
I260 0E 13 B4 FF FF 13 6F 35 07 32 A5 13 59 BA FF FF
I270 13 CF 13 59 3A 01 10 07 37 37 0C 01 0A 00 02 2A
I280 1A 0B 01 3F 13 00 37 37 02 09 35 02 2A 07 0B 00
I290 2E 0C 1D 00 12 0F 00 02 0D 0F 02 32 00 0F 23 00
I2A0 14 00 02 2A 13 B0 C6 5A 0B 15 B0 FF
```

NOTE 1. APPENDIX-B is the saae as APPENDIX-A, except for two address. These are X09F and X0A0 (MSB and LSB respectively, labeled MS and LS above). Place the origin of the MAIN-CONTROL-PROGRAM (see APPENDIX-F) in these locations so that

APPENDIX-C

EXCEPTION-WORD ENCODING SCHEME

To store a unique word or symbol and its corresponding allophone address string in an efficient and flexible manner, the following encoding format was derived:

([encoded word or symbol](= [encoded allophone address(es)]

where: (equals 13H.
[equals 40H.
] equals 80H.

The first and last byte is 13H. This informs the code-to-speech algorithm that the word or symbol is not a prefix or suffix.

If the word or symbol is an individual letter, then the representation of it between the brackets is an FFH; this includes the value of the left and right brackets.

Otherwise:
(1) The first letter in the word or symbol is always to be ignored.
(2) The next letter in the word is represented by the value of the letter from TABLE-7, plus the value of the left bracket "[" which is 40H.
(3) The following letter(s), if and only if it is not the last letter in the word or symbol, is represented solely by its value from TABLE-7.
(4) The last letter in the word or symbol is represented by the value of the letter from TABLE-7, plus the value of the right bracket "]" which is 80H.

The allophone address string is encoded in a similar manner:

If only one allophone is used for the pronunciation, it is represented by its value from TABLE-8, plus the value of the right "[" and left "]" brackets which are 40H and 80H respectively.

Otherwise:

(1) The first allophone is represented by its value from TABLE-8, plus the value of the left bracket "[" which is 40H.
(2) The following allophone(s), if and only if it is not the last allophone in the string is represented by its value from TABLE-8.
(3) The last allophone is represented by its value from TABLE-8 plus the value of the right bracket "]" which is 80H.

Example: To encode "Au" to pronounce as "GOLD"
([Au](= [GG2 OW LL DD1]
13,F5,13, 7D, 35,2D,95 ← This line is ready to store in EXCEPTION-WORD eprom under the "A" category.
(The encoded string is shown in Hexadecimal notation.)

Remember, throw away the first letter (in this case an "A"), then find the value of the next letter in TABLE-7 and add 40H plus 80H to it so as to represent the left "[" and right "]" brackets.

APPENDIX-D

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!      USER EPROM MAP          (For use without EXCEPTION-WORD eprom)        !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

NOTE: ENCAPSULATED SEQUENCES ARE USER-DEFINED, REFER TABLES 2,3, AND 4.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
X000	80	48	28	58	85	E0	35	E0	31	FF	FF	FF	FF	FF	FF	FF	←sample NEW PARAMETERS. (see table 1).
X010	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	
X020	FF	FF	FF	1E	1F	20	21	28	29	24	25	22	23	2A	2B	26	←NEW PARAMETER INITIALIZATION ROUTINE.
X030	27	2C	2D	2E	2F	32	33	34	35	36	E0	65	78	02	31	BE	
X040	F1	43	C5	AA	X0	09	2D	FF	E2	1E	B8	AA	X0	23	D5	12	The MSnibble of the following locations from the NEW PARAMETER INITIALIZATION ROUTINE are user defined also: X044,X04C,X057,X05F,X06E,X07E,and X084; where X=1,2,3,4,5,6,7,8,9,A,B,C,D, or E.
X050	D0	13	B9	9B	13	C3	AA	X0	09	2D	FF	E2	0B	BB	AA	X0	
X060	23	D5	12	D0	13	B9	9B	13	5D	16	E6	E9	C3	AA	X0	09	
X070	2D	FF	E2	14	A2	40	11	B2	11	A2	15	11	C3	AA	X0	09	
X080	82	15	C3	AA	X0	09	82	14	98	29	03	98	28	07	22	20	
X090	9B	03	BE	F7	2B	98	03	05	98	07	09	98	03	19	BC	MS	←(see note 1 below).
X0A0	LS	BC	F3	F4													

User code may start at X0A4, but must contain the MAIN-CONTROL-PROGRAM somewhere within, refer to APPENDIX-F.

NOTE 1.Place the immediate address of the origin of the MAIN-CONTROL-PROGRAM (see APPENDIX-F) in these locations; so that program control will transfer to the user's code at the appropriate time.

APPENDIX-E

```
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
X      USER EPROM MAP            (For use with EXCEPTION-WORD eprom)     X
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

NOTE 1. Contains no reserved locations, except for the MAIN-CONTROL-PROGRAM. (See APPENDIX-F).

NOTE 2. A user's code does not have to reside in a second eprom (USER eprom). It may reside in an unused portion of an EXCEPTION-WORD eprom which is for use where "USER eprom is present". Refer APPENDIX-B.

```
;*****************************************************************
;*  USER's MAIN CONTROL PROGRAM (for residency anywhere within USER eproms).  *
;*****************************************************************
```

NOTE: ENCAPSULATED AREAS ARE USER DEFINED UNLESS OTHERWISE NOTED.

```
F1AC =          AUDIBLE  EQU 0F1ACH     ;<-+
F3E7 =          GISPEECH EQU 0F3E7H     ;<-+- THESE ARE ADDRESS VECTORS WITHIN
F1E2 =          SAVE     EQU 0F1E2H     ;<-+- THE MASKED CODE-TO-SPEECH ALGORITHM.
F1F0 =          ESCAPE   EQU 0F1F0H     ;<-+
0008 =          F2       EQU R11
0002 =          F1HI     EQU R2
0003 =          F1LO     EQU R3
0004 =          R1HI     EQU R4
0005 =          R1LO     EQU R5
0007 =          F2LO     EQU R7
0009 =          R2LO     EQU R9
0038 =          WORDCNTH EQU R56
0039 =          WORDCNTL EQU R57
0032 =          BUFBVALU EQU R50
0000 =          IOCNT0   EQU P0

9000            ORG >9000               ;This is the origin of the Main Control Program which is defined by the user.
                                        ;Here it is arbitrarily chosen to be 9000H.  Remember to place this immediate
                                        ;address in the "MS","LS" locations of the EXCEPTION-WORD eprom ("for use with
                                        ;USER eproms"), see APPENDIX-B.  (MS=MSB=90 and the LS=LSB=00 in this example.)

9000 BEF1AC     MESSAGE: CALL @AUDIBLE
+-------------------THIS ENCAPSULATED AREA IS NOT USER DEFINED--------------------+
| The following two lines are placed here only if the USER code wishes to gain   |
| access to the serial port.                                                     |
|IIII IIII        ANDP I>FE,IOCNT1    ;DISABLE INTERRUPT-4 (SERIAL PORT).       |  (The IIII IIII here does not have
|IIII IIII        ANDP I>FE,PORTB     ;SET BUSY: LO.                            |  the same meaning as the I from the
+--------------------------------------------------------------------------------+  previous appendices and tables.)
9003 E00E               JMP ANYSTART

9005 BC9046     CRSTART: BR @USERCODE   ;THE BRANCH ADDRESS BELOW IS USER DEFINED.
                                        ;AFTER INITIALIZATION OR AFTER PROCESSING AND SPEAKING
                                        ;WHAT HAS BEEN LOADED INTO THE INPUT BUFFER, CONTROL
                                        ;TRANSFERS TO THE USER CODE VIA THIS BRANCH INSTRUCTION.
9008 76010B07   SPEAK:  BTJO I>01,F2,ANYSTART
900C 73EF08             AND I>EF,F2
900F 77100BFC   CRWAIT:  BTJZ I>10,F2,CRWAIT
9013 4D0305     ANYSTART: CMP F1LO,R1LO
9016 E607               JNE HOLEWORD
9018 4D0204             CMP F1HI,R1HI
901B E602               JNE HOLEWORD
901D E0E6               JMP CRSTART
901F 7D0038     HOLEWORD: CMP I>00,WORDCNTH
9022 E605               JNE BFULTEST
9024 7D0039             CMP I>00,WORDCNTL
9027 E2F6               JEQ HOLEWORD
9029 77080B09   BFULTEST: BTJZ I>08,F2,PROCESS
902D 7D0132     LOCKUP:  CMP I>01,BUFBVALU
9030 E211               JEQ ESC
9032 760B0BFC   BFULHOLD: BTJO I>08,F2,BFULHOLD
9036 BEF3E7     PROCESS:  CALL @GISPEECH
9039 4D0709     MAINROUT: CMP F2LO,R2LO
903C E2D5               JEQ ANYSTART
903E A40100             ORP I>01,IOCNT0
9041 E0D0               JMP ANYSTART
9043 BCF1F0     ESC:     BR @ESCAPE
```

```
                                ;AT THIS POINT IT IS THE USER CODES RESPONSIBILITY
                                ;TO EXECUTE ITS OWN CODE OR TO LOAD A CHARACTER STRING
                                ;INTO THE INPUT BUFFER.
                                ;THE TWO EXAMPLES SHOWN BELOW DEMONSTRATE THE
                                ;RECOMMENDED SEQUENCE OF EVENTS FOR EACH MODE.
                                ;MODE 1 IS USED WHEN THE USER CODE HAS PREVIOUSLY
                                ;PREPARED THE CHARACTER STRING IT WISHES TO HAVE
                                ;SPOKEN; MODE 2 IS USED WHEN THE USER CODE WISHES
                                ;TO EXECUTE ANYTHING ELSE.
                                ;
MODE1:                          ;LOADING INPUT BUFFER OF CODE-TO-SPEECH ALGORITHM:
                                ;
                                ;ACCUMULATOR AND STATUS REGISTER ARE TO BE SAVED.
                                ;NO OTHER REGISTER IS TO BE MODIFIED.
                                ;Loading a character string is accomplished
                                ;by placing each character into the Accumulator and
                                ;then using CALL @SAVE to load it into the input
                                ;buffer.  Remember to end each word or phrase with a
                                ;delimeter.  Restore the Accumulator and the Status Registers.  Call @SPEAK to process
                                ;and speak the word(s) or phrase(s) that were loaded.
                                ;
NOTE:  Once "SPEAK" is initiated, control does not return to the USERCODE until the last word or phrase
that is in the input buffer has been processed by the code-to-speech algorithm.
NOTE:  Because of masked code-to-speech restrictions, the USER can not intercept input from the serial
port while speech processing is in progress.  During this interval, handshaking (BUSY#)
shall hold off additional serial communication.  This is accomplished by the two encapsulated lines shown above.
                                ;
                                ;THE FOLLOWING EXAMPLE WILL LOAD THE LETTER "A" AND
                                ;SPEAK IT:
                                ;
9047 0E         PUSH ST         ;SAVE CONTENTS OF STATUS REGISTER.
9048 B8         PUSH A          ;SAVE CONTENTS OF ACCUMULATOR.
9049 2241       MOV 1)41,A      ;MOVE 41H (which is ASCII "A") into the ACCUMULATOR.
904B BEF1E2     CALL @SAVE      ;LOAD THE ASCII "A" INTO THE INPUT BUFFER.
904E 222D       MOV 1)0D,A      ;MOVE 0DH (which is a carriage return).
9050 BEF1E2     CALL @SAVE      ;LOAD THE DELIMETER INTO THE INPUT BUFFER.
9053 B9         POP A           ;RECOVER CONTENTS OF ACCUMULATOR.
9054 08         POP ST          ;RECOVER CONTENTS OF STATUS REGISTER.
9055 BC9008     BR @SPEAK       ;TRANSFER CONTROL TO THE MAIN-CONTROL-PROGRAM WHICH
                                ;WILL ACCESS THE CODE-TO-SPEECH ALGORITHM; AFTER WHICH
                                ;THE CONTROL WILL RETURN TO THE "BR @USERCODE" INSTRUCTION LOCATION.
                                ;
9058 00         MODE2:  NOP     ;The following is the recommended
                                ;sequence of events necessary for the user's code
                                ;to do anything else (except for loading the input
                                ;buffer as described under MODE 1.)
                                ;
                                ;SAVE STATUS REGISTER
                                ;SAVE REGISTER 0 THRU 39H (EXTERNAL-RAM MODE), along with 3AH thru current Stack Pointer.
                                ;OR, SAVE REGISTER 0 THRU 7FH (INTERNAL-RAM MODE).
                                ;(DO NOT USE PUSH INSTRUCTIONS TO SAVE THE REGISTERS BECAUSE
                                ;THE STACK IS NOT LARGE ENOUGH, INSTEAD
                                ;BLOCK MOVE THE RESPECTIVE REGISTER CONTENTS INTO EXTERNAL-USER-RAM.
                                ;
                                ;USER DEFINED CODE GOES HERE NEXT.
                                ;
                                ;(TO READ THE SERIAL PORT, SEE THE EXAMPLE SEQUENCE BELOW).
                                ;
                                ;THEN RECOVER RESPECTIVE REGISTERS.
                                ;RECOVER STATUS REGISTER.
                                ;BRANCH TO MODE 1, OR BRANCH TO OTHER USER CODE such as
```

```
                        ;The following is the recommended sequence of events necessary
                        ;for the user's code to obtain input from the serial port:
                        ;
LOOP:   ORP I>01,IOCNTI ;ENABLE INTERRUPT-4 (SERIAL PORT) BECAUSE WANT TO RECEIVE SERIAL INPUT.
        ORP I>01,PORTB  ;SET BUSY: HI.
        IDLE            ;WAIT HERE FOR SERIAL INTERRUPT TO OCCUR AND TO BE SERVICED.
        ANDP I>FE,IOCNTI ;DISABLE INTERRUPT-4 (SERIAL PORT).
        NOP             ;
                        ;THE CHARACTER RECEIVED BY SERIAL PORT IS IN THE ACCUMULATOR,
                        ;SO USER MAY EVALUATE IT HERE.
                        ;
        MOV I>08,A      ;LOAD A "BACKSPACE" INTO ACCUMULATOR IN ORDER TO TELL
        CALL @SAVE      ;THE CODE-TO-SPEECH INPUT BUFFER TO IGNORE THE CHARACTER
                        ;WHICH ARRIVED VIA THE SERIAL PORT.
        NOP             ;
                        ;IF USER WANTS ADDITIONAL CHARACTERS FROM THE SERIAL PORT TO EVALUATE:
                        ;JUMP TO LOOP TO WAIT FOR NEXT SERIAL PORT INTERRUPT (JMP LOOP).
                        ;
                        ;OTHERWISE:  ENABLE INTERRUPT-4 (ORP I>01,IOCNTI), SET BUSY: LO (ANDP I>FE,PORTB),
                        ;THEN FALL THRU TO REST OF USER CODE.
```

NOTE: To successfully incorporate a USER program with the code-to-speech algorithm requires a thorough understanding of the concepts described in this application note, and an in-depth working knowledge of PIC7001 assembly language.

END OF APPLICATION NOTE AN-0505 REVISION C

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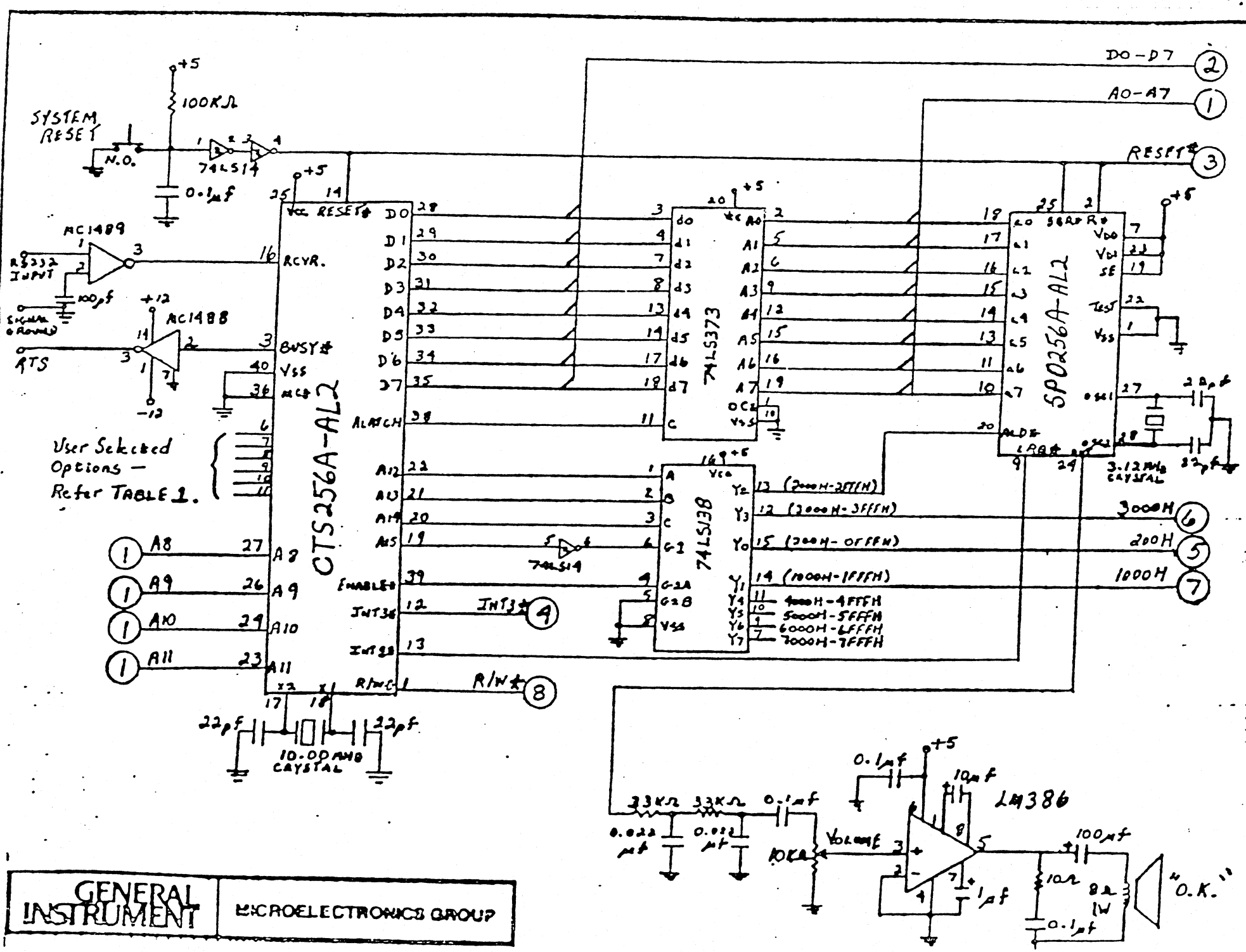
SYSTEM RESET
N.O.
100KΩ
0.1μf
74LS14
+5
DO-D7
AO-A7
RESET*
MC1489
RS232 INPUT
100pf
SIGNAL GROUND
MC1488
ATS
+12
-12
CTS256A-AL2
RCVR.
BUSY*
Vss
MCP
ALATCH
A12
A11
A10
A9
A8
ENABLED
INT3S
INT2S
R/W*
X2
X1
22pf
22pf
10.00MHz CRYSTAL
User Selected Options — Refer TABLE 1.
INT3*
R/W*
74LS373
74LS138
74LS14
SP0256A-AL2
3.12MHz CRYSTAL
3000H
200H
1000H
(2000H-27FFH)
(3000H-3FFFH)
(200H-07FFH)
(1000H-17FFH)
4000H-4FFFH
5000H-5FFFH
6000H-6FFFH
7000H-7FFFH
LM386
33KΩ
33KΩ
0.1mf
0.022 μf
0.022 μf
10KΩ
Volume
10μf
100μf
1μf
10Ω
8Ω 1W
0.1μf
"O.K."
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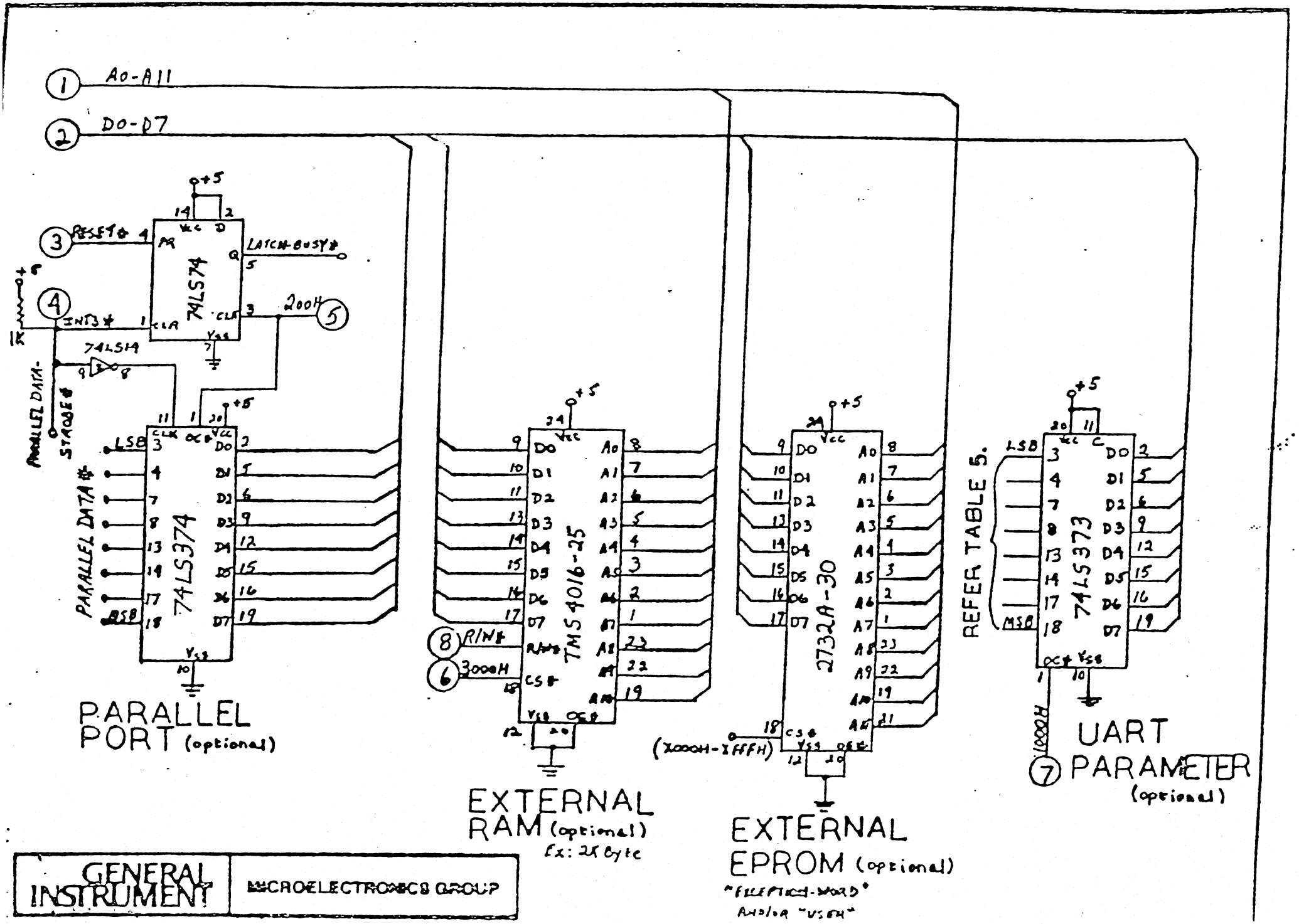
1 A0-A11
2 D0-D7
3 RESET
4 INIT
5 200H
6 3000H
7 1000H
8 RINT
74LS74
74LS14
74LS374
PARALLEL DATA
PARALLEL DATA STROBE
PARALLEL PORT (optional)
TMS4016-25
EXTERNAL RAM (optional)
Ex: 2K Byte
2732A-30
(X000H-XFFFH)
EXTERNAL EPROM (optional)
"PROGRAMMED-WORD" AND/OR "USER"
74LS373
REFER TABLE 5.
LSB
MSB
UART PARAMETER (optional)
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